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FOREWORD

Thirty years ago—on April 5, 1956—the Institute for Defense Analyses was created at the request of the Secretary of Defense. From that time until the period this report describes, IDA contributed important ideas that have played significant roles in a broad spectrum of developments central to US national security today: over-the-horizon radar; ballistic missile defense; multiple, independently targetable reentry vehicles (MIRVs); TRIDENT-type submarines; forward-looking infrared systems; the advanced SIDEWINDER AIM-9L missile; concepts of electronic sensing and battle management (initially applied on a large scale in the Vietnam conflict); and many others. As we will indicate in the following pages, IDA continues to make significant contributions to the national security.

The initial purpose in creating IDA was to encourage increased interaction between scientists and engineers in the universities and a small group of analysts in the Office of the Joint Chiefs of Staff known as the Weapons Systems Evaluation Group (WSEG). Strengthening support of the Joint Chiefs of Staff in this way, as well as providing a resource for the Assistant Secretary of Defense for Research and Engineering, was intended to make available to the Department of Defense independent evaluations by able professionals using advanced analytical methods.

This was a logical extension of the successful application of operations research by the Army, Navy, and Air Force during and after World War II and Korea. Scientific and technical issues arose not only in actual military operations but also as new defense systems were considered, built, and introduced, and as new force structures, missions, and tactics were developed and adopted. Since those early days, IDA, as the Institute for Defense Analyses is known, has maintained itself as a resource for undertaking independent and objective analyses of many major issues as they arise, especially those that transcend Service

boundaries. Our steadfast purpose was and continues to be to bring scientific and scholarly expertise of the highest quality and objectivity to bear on problems of national security.

A strong thread of continuity underlies IDA's work, and in recent years that continuity has been overlaid with changes made in response to external and internal developments. Ten years ago our predominant effort was directed toward technical analyses of projected weapon systems. These efforts continue today, but we also focus significant effort on evaluation of operational tests, on cost and resource management, on computer technology, and on force structure planning. IDA enjoyed a unique relationship in the 1960s with the Joint Chiefs of Staff (JCS) as the principal source of technical and analytic advice for the JCS; this relationship waned during the seventies but reemerged in important respects in the 1980s. At the same time other elements of the Department of Defense, especially in the Offices of the Secretary of Defense and the Under Secretary of Defense for Research and Engineering, began making more sophisticated and specialized use of IDA and its professional skills. The spectrum of sponsoring agencies had broadened.

IDA's work in the mid-seventies was sponsored mainly by the Director of Defense Research and Engineering, the Advanced Research Projects Agency, the Director of Defense Test and Evaluation and, to a lesser degree than in earlier years, by the Joint Chiefs of Staff. Today the Institute still works mainly with these agencies or their successors, but has been tasked with other important work for elements of the Office of the Secretary of Defense such as the Under Secretary for Policy, the Director of Program Analysis and Evaluation, the Assistant Secretary for Acquisition and Logistics (now the Under Secretary for Acquisition, who has also absorbed the Research and Development and Logistics functions), the Assistant Secretary for Command, Control, Communications, and Intelligence, and the Strategic Defense Initiative Office. Additional sponsorship comes from non-Service defense agencies such as the Defense Communications Agency and Joint Program Offices established to manage DoD-wide efforts to advance computer technology and its use. Something less than ten percent of IDA's effort is non-DoD sponsored; for example, early in this period by the Federal Aviation Administration and the Agency for International Development, and more recently by the Federal Bureau of Investigation.

This report on IDA's development over the most recent third of its existence describes the nature of IDA's contribution and its

response to changing times and changing needs. It focuses on how IDA has adapted to shifts in the national security environment, to the impact of new, advanced technologies, and consequently to a changing menu of issues connected with acquisition, introduction, and employment of weapons and associated systems in the missions, force structures, and tactics of the Services.

William Y. Smith, General, USAF (Ret.)
President and Chief Executive Officer

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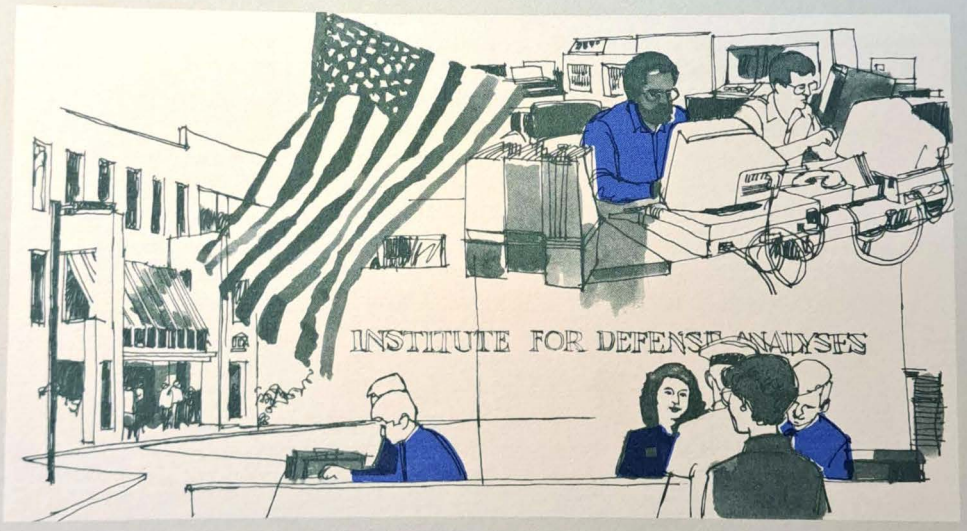
Chairman of the Board of Trustees

BACKGROUND

Analyses of technical and policy options in the national security domain form the core of IDA's work. Such analyses cannot be performed independently of events and national attitudes affecting our national security. This past decade has seen the public temper shift from shunning the burden of national security in the early post-Vietnam War years, to vigorous support for national defense, to the present rising concern about its costs. While the broad aspects of many defense issues have not changed, the details certainly have, as have the applicable solutions. IDA's research program has been affected by these changes in the defense environment and, for this reason, IDA's evolution can be better understood when read against a brief historical note of trends that had important influences on it.

First the international scene: A significant shift in international defense issues took place as the number of nations and issues affecting the security of the United States and its allies increased. There were significant fluctuations over the past decade in our relations with the USSR, whose massive upgrading of military capabilities had become convincingly apparent by the mid-seventies. This impelled variations in the balance of power and politics between NATO and the Warsaw Pact nations and in our relations with our own allies. The continuing diffusion of military and economic power among the nations of the world, coupled with the spread of technology, replaced the earlier focus on straightforward superpower confrontation. The potential for conflict and the entanglements of international terrorism expanded with instabilities simmering simultaneously in Africa, Central America, and Asia, and even within the advanced nations of Western Europe. Thus the Nation's strategic and tactical military requirements were spread wider and over more diversified ground as the nature of real and potential conflicts diversified and as pluralism spread amongst our allies as well as our adversaries.

Secondly, there were changes in the Department of Defense: Early in the 1980s, more and more management responsibility for development and deployment of weapons devolved from the Office of the Secretary of Defense (OSD) back to the Services. More recently the trend is in the other direction. Within the DoD itself, increasing emphasis on the process for acquiring weapons systems was reflected in the OSD by attention to the policy aspects of managing the flow of systems and technology into the Armed Forces and abroad. The combination of increasing diversity of situation, advancing technology, concerns over force survivability in war, and the normal desire of people in complex, layered organizations to keep in touch with one another, increased the requirement for analyses having to do with communications and management. IDA, involved earlier with studies bearing on changing technology, systems operation, and test and evaluation, became additionally involved with command and control, communications, defense-wide resource management issues, force structures, and quick-reaction technical support.



Thirdly, there was the changing pattern by which OSD, the Joint Chiefs of Staff, and other defense agencies used more professional service firms to help them manage their expanding responsibilities. Acceptance of dedicated, nonprofit studies and analyses centers such as IDA fluctuated over the decade. A

proliferation of organizations capable of doing defense analyses, both inside and outside the Defense Department, had the ultimate effect of attracting Congressional interest to the manner of managing defense study contracts—both for-profit organizations and the not-for-profit Federally Funded Research and Development Centers (FFRDCs). IDA's utility, record, and continuing presence as a resource during this period stood it in good stead. DoD's review of IDA as an FFRDC (the *Walsh Report* of 1982) concluded that IDA served a valued function but that the interaction between the Pentagon and the Institute should be improved. In the years since, the Pentagon has taken better advantage of the opportunities IDA's skills offer, and IDA in turn has improved its responsiveness. Today IDA remains one of the main studies and analyses centers in the defense area that is dedicated to performing the mission exclusively for non-Service, non-industrial sponsors.

In sum, as national security problems grew more complex during the last decade with the introduction of new technologies, more complex defense organization, and spreading diffusion of power on the international stage, IDA adjusted to maintain its effectiveness. IDA today serves a broader field of sponsors than it did ten years ago. A close and unique relationship with a few elements of the Department of Defense has expanded into a more widely varied, but continuing and recognized role with a greater number of agencies of the Department.

PROGRAM AND ORGANIZATION

IDA's strength is greater than the sum of its parts. That strength lies in IDA's whole approach to public service, in the relations it has with its sponsors, in the ambience it provides for professional work, and in the results of its work. We assume this central understanding of the importance of teamwork in the summary of what follows: IDA's response to changing needs.

Of the eight Divisions now in IDA, two carry on the work of the original Weapons Systems Evaluation Group. The System Evaluation Division (SED) performs evaluations of future air, land, and sea warfare systems—and it studies how these systems will perform and how alternative systems for a mission will compare with each other in terms of cost and effectiveness. The Operations Evaluation Division (OED) continues the test and evaluation function in a role that currently involves the functions of reviewer and expert consultant in the system tests that are an increasingly important element in systems acquisition decisions. In addition, OED has pioneered a role as an analytic resource for the Unified Commands in areas bearing on military operations. One Division has remained essentially unchanged in mission and approach over the decade—the Communications Research Division (CRD) in Princeton, NJ.

Two Divisions have embraced new or expanded functions as the sponsors' requirements have changed. The Science and Technology Division (STD), the second of the original two Divisions forming IDA, and performing work in advanced technology for the Director of Defense Research and Engineering and the Advanced Research Projects Agency, has taken on a seminal task in helping lay the groundwork for research in the Strategic Defense Initiative, and has expanded its work in the military training field and in the security of technology with military applications. The Strategy, Forces and Resources Division (SF&RD), formed by the joining of two earlier Divisions, combines work on force capability assessments, force costs, and

defense economics, and their combined impact on national security—broader scope than the individual efforts of its progenitors.

Three Divisions are new, although all have roots in earlier work. The Computer and Software Engineering Division (CSED) was formed in partial response to the need for research concerning the impact of computers on defense planning and execution. CSED is concerned with improving DoD's ability to move computer hardware and software from the laboratory into operational systems. The Supercomputing Research Center (SRC) is a separately housed research organization whose function it is to lead Defense investigations into the problems involved in key aspects of supercomputing. The Cost Analysis and Research Division (CARD), expanded from a group that had largely conducted cost analyses for other IDA Divisions to one that performs much-needed research for the DoD to improve cost assessment and estimating procedures—especially as they involve the impact of new technologies on development and production for which there is no track record.

These eight Divisions form a spectrum that ranges from investigations into and application of basic technologies to weapon and supporting system requirements, through development, to the impact of systems' introduction into the armed forces and the impact of the systems on resources, and finally, to assessments of strategy and operations.

Deciding what systems are important and potentially most useful in an increasingly complex technological environment, and managing the advance of technology and acquisition of military systems in that environment, has come to occupy an increasingly greater part of DoD's attention. There is a shift in emphasis from weapons-oriented to management-oriented issues. Increasing attention is being placed on computing, testing, and field operations.

The decade covered by our report saw "smart" weapons introduced into wider operational use—weapons that adjust their course while in flight to a target or home on a target signature. These are also the years that saw the battle zones under study deepen, with increasingly global surveillance of operations and extended ranges of weaponry. These years saw emphasis being placed on attacking strategic missiles during the boost phase, and on attacking threats to the Fleet hundreds of miles from their targets. These years also saw the introduction of technology to make the command, control, and communications structure better able to serve commanders' needs in a short time while becoming

more dependent on worldwide communications and critical elements in space—providing both greater facility and increasing vulnerability to enemy action and to simple failure.

The changes in the IDA program reflect this evolution of national security issues on a broad scale. IDA has risen to the challenge of technology and, as we will illustrate in the following sections, the Divisions of IDA have dealt successfully with some unique and demanding changes in the national security environment.

Furthering, Using, Protecting, and Applying Advanced Technology

Over the years IDA has developed, for the Director of Defense Research and Engineering and the Advanced Research Projects Agency, deep expertise in sensor technology, materials, and training. During the decade on which we report, IDA continued to make important contributions to solving problems of infrared detection which helped the DoD rationalize a previously uncorrelated set of developments in electro-optical systems, helped it begin to account for the then poorly understood effects of weather, and helped it plan the orderly acquisition of a family of infrared-guided weapons and night-viewing devices for the ground and air forces. In new composite materials, IDA helped plan research and development programs that contributed to the current position of the United States at the forefront. In training management, the Institute helped in the application of advanced

technology for training increasingly scarce and expensive active and reserve personnel, resulting in their more effective use and considerable savings.

When the importance of protecting our Nation's lead in militarily applicable technologies was recognized in the Export Administration Act of 1979, IDA was asked by the Under Secretary for Defense Research and Engineering to apply its knowledge and experience in helping to establish guidance for responding to license requests for export of militarily sensitive advanced technology. This resulted in the preparation of the Militarily Critical Technologies List (MCTL) required by the law. IDA continues that work today, and acts in an advisory capacity in the US negotiations at COCOM, a coordinating committee comprising industrialized nations that collaborate on the protection of technology important to the defense of the free world. Most of this work is concentrated in IDA's Science and Technology Division (STD).

Advancing technology solves some crucial problems and produces others. Twenty-five years ago IDA worked on intercontinental ballistic missile reentry problems. They were solved. Today, expanded DoD reliance on computers in command, control, communications, and weapons systems—the unprecedented complexity of the daily business of the DoD in peace and in war—pushes the state of the art in the science and technology of computer hardware and software engineering. The growing importance and significance of computer capability and potential prompted IDA management, in 1983, to create the Computer and Software Engineering Division (CSED) to support the DoD in meeting its increasingly complex computer-age requirements. CSED's purpose was to analyze and define state-of-the-art and state-of-practice issues, alternatives and strategies in the overall engineering of DoD computer systems. Particular attention was given to supporting DoD efforts in the definition and standardization of Ada, which has been adopted as the DoD standard language for computer subsystems embedded in the hardware of weapons systems. In the three years since its inception, CSED has been providing computer-oriented expertise in the areas of software engineering tools, high-order programming languages, computer-aided engineering environments, computer security against outside penetration, computer operating systems, hardware/software tradeoffs, man/machine interactions, artificial intelligence and expert systems, and several other cutting edge technologies that form the foundations of the science.

Evaluating Proposed System Developments and Operational Effectiveness

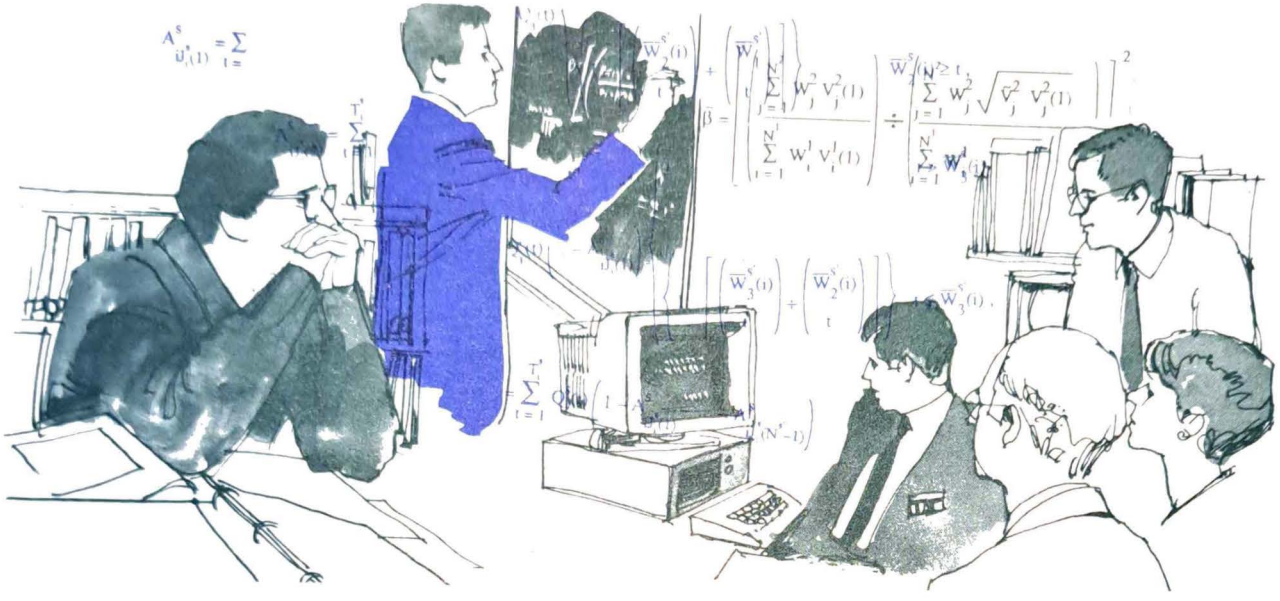
Effective weaponry—will a system work in the field as is intended—involves two major steps before the system is introduced into the real world. The first is to specify its purpose, how it is to perform, and which of the alternative ways of accomplishing this purpose should be chosen. The second is to make certain it performs as expected under operational conditions before it is ordered into production and acquired for the forces in the field—fly before buy.

Three of IDA's Divisions concentrate on these steps. The System Evaluation Division (SED) assesses the potential performance of systems proposed or in various stages of development—the concept of "systems" encompassing, as examples in the narrowest sense, individual aircraft and, in the broadest sense, an aircraft as an element of an air defense system comprising surveillance and command, control, communications (C^3) subsystems as well as a multiplicity of aircraft being guided and controlled by the surveillance and C^3 parts of the larger system. Emphasis is on the relationship of system effectiveness to technical characteristics, ways of using the system after deployment, and vulnerability to countermeasures. The range of IDA interests here is broad, including both strategic and tactical systems. Strategic system studies have included examination of alternative force mixes, strategic command, control, and communications, space defense, and issues associated with the strategic bomber force. Strategic air defense has been a recurring theme of recent systems evaluation work that has explored US options for defense against Soviet bombers and cruise missiles—an area of particular interest in light of the strategic missile defense program and the possibilities of significant reduction of ballistic missiles.

Over the last decade, work in the tactical area has involved an increasingly substantial IDA effort on issues concerning the use of advanced-technology systems in the military forces and the costs of such use. There has been a growing program of studies in tactical command and control—on how to keep aircraft in combat operating against their targets and not against each other, on how field forces can communicate with each other, on how to locate enemy forces, on how to overcome enemy electronic warfare, and many related matters.

Few weapons systems have capabilities that stay neatly within the boundaries of defined Service missions. The spillover

calls for Service-independent judgment and tough, impartial assessment. IDA was initially involved in designing joint tests to evaluate the operational effectiveness of weapons systems and in analyzing for the OSD the results of tests that the Services themselves had performed. Now operational test and evaluation is



mandated by law before a commitment to buy is made. IDA's role has evolved into giving technical advice on whether or not test programs will yield the answers needed for production decisions, and on the validity of the test results; thus IDA has much to do with providing information about the adequacy of the basis for judging the operational effectiveness of systems. The IDA program in operational test and evaluation, which was begun in the early 1970s, is now conducted largely by the Operational Evaluation Division (OED).

IDA's usefulness in this work has resulted in another program, recently begun, to provide analytical support to some of the Unified Commanders (CINCs) in the areas of war gaming and war plan development and evaluation. The CINCs receiving IDA support include the European Command, the Pacific Command, the Readiness Command, and the Central Command.

In the war gaming area, IDA conducts a supporting analytical program at the Battle Commanders Training Facility located at the Warrior Preparation Center in Germany. This is an interactive war gaming facility of the US European Command where IDA analysts assist the Service commanders—Corps level through Army Group level—in simulating activities in which they

would engage in actual warfare. The commanders run these simulated exercises to observe and to practice command and control with their staffs. The analyses of these exercises, which constitute IDA's main contribution, are forwarded to the CINCs for their evaluation and to help identify strengths and weaknesses in command and control, in planning, and in execution of plans. IDA is also assisting the Readiness Command to develop a war gaming capability.

IDA has several projects in the area of war plan evaluation. For the Pacific Command, IDA has structured an evaluation system to assist the staff in quantitatively assessing its war plans and developing the associated budget issues. For the European Command, IDA is conducting a multi-year project to review and analyze the plans for the rapid reinforcement of Europe should a conventional air-land war break out in Central Europe. Similar projects are being conducted for the Central Command.

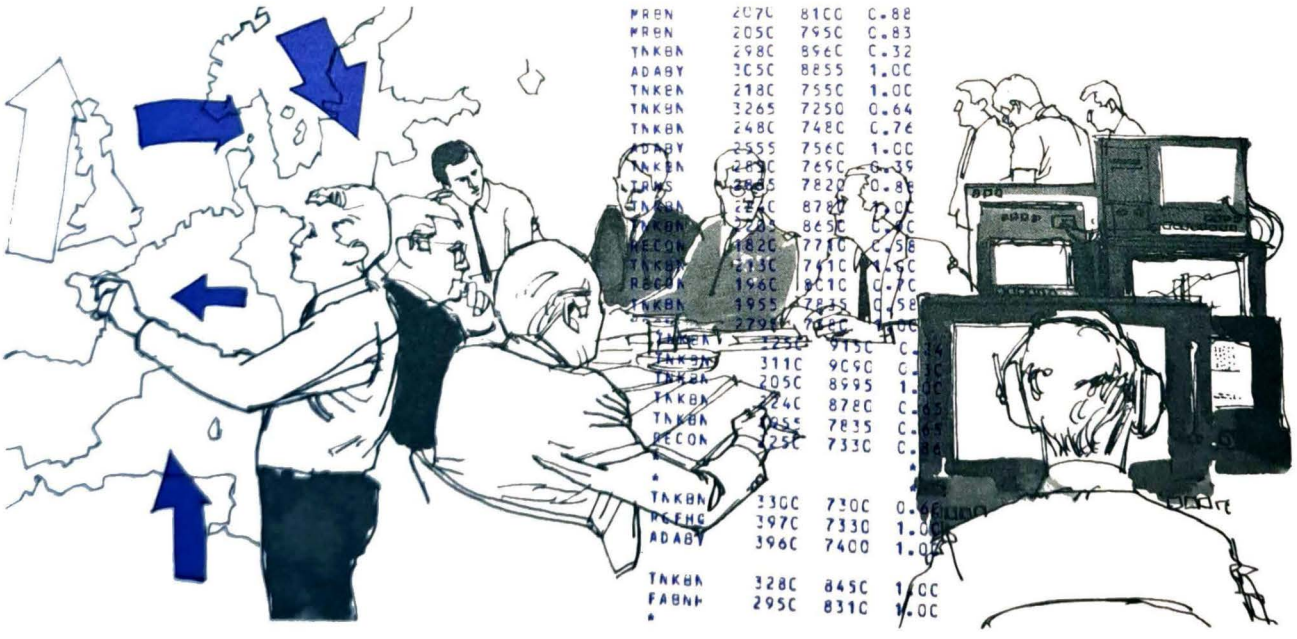
Overviews and Resource Analyses

One of the major evolutions in IDA's program over the decade came about to help DoD manage acquisition of forces, and the resources needed to create and sustain them. How well a system performs is, of course, only part of the story. What demands it places on the national economy, resources, and manpower are fundamental to deciding on its practical usefulness. Some political and societal aspects of national security were analyzed by IDA in its early years, but this kind of work did not merge easily with the more technical and mathematically oriented work for which IDA had been founded. Economic issues, though susceptible to quantitative techniques, tended to be decoupled from most of the weapons-oriented studies.

This last decade has seen IDA better define its role in these broad areas by melding technical, economic, and political analyses into an integrated strategic approach with a quantitative analytic base in the Strategy, Forces and Resources Division (SF&RD). SF&RD combines the work of earlier Divisions that had addressed independently the issues of strategy, of the effectiveness of forces, and of the resources to provide for and sustain them. Prior to the 1980s, defense economics studies had been undertaken in the Program Analysis Division (PAD). Foreign affairs and national security strategy were the province of the International and Social Studies Division which, on treating the strategic implications of broad force-wide issues, became the

International Security Assessment Division (ISAD) in 1979 and then the Strategy and Forces Division (SFD) in 1983. SF&RD was formed in 1984 by merging SFD—with its military and policy experience, and PAD—with its technical expertise for model building and defense economics. This organizational braiding produced the inclusion of "hard" analytic techniques into the previously more qualitative study of strategic issues. It satisfied the need for a quantitative overview of how technical systems and forces combine to operate under different conditions of national strategy.

An example of such a recent study was one whose purpose it was to help the Joint Chiefs of Staff answer the questions of total forces capability assessment (TFCA): to what extent do the existing forces of the United States meet obligations placed on them by national policy and commitments? This involves methodological contributions on IDA's part to multi-theater analysis, and includes both conventional and all-out-war capabilities and problems in joint command. In other areas, extensive analyses by IDA, led by SF&RD, have helped NATO articulate and verify the soundness of its plans to capitalize on advanced technology to deny Soviet ability to reinforce conventional forces along a front during a possible attack on NATO. During the period 1983-1986, at the request of the Chairman of the Joint Chiefs of Staff, IDA devised a group of major computer models, currently being implemented by the Organization of the Joint Chiefs of Staff, for assessing the impact of force and/or budget changes on the ability of America's armed



forces to carry out our worldwide military commitments.

In another area, Theater Nuclear Forces (TNF) and chemical warfare studies for the Assistant to the Secretary of Defense, Atomic Energy, involve exploring the rationale of deterrence by assessing today's potential battlefield so as to allow analysis of the contribution to war-fighting, and therefore to deterrence, by each element of the force. Among other things, this gives planners a better idea of what is essential to maintain and what, under the pressure of negotiations, might be given up without a major effect on security. IDA is also looking into how capable industry is of responding to various mobilization scenarios, and how it can be made more capable of responding, for the Joint Chiefs of Staff and for the Under Secretary of Defense for Policy.

Cost Assessment and Analysis

Accurately estimating what a system or force component will cost depends upon previous experience with similar developments, on explicit records of what happened in specific cases, and on judicious interpretation of this scattered information to fit the current case. The gaps and uncertainties can be significant, and with changes in technology, manufacturing methods, materials used, and components involved, cost estimating can be hazardous and even misleading.

IDA has greatly strengthened its capability in the area of cost analysis and research with the purpose of creating knowledge the DoD could use to help them improve prediction of defense systems' costs in a changing technological world. For years IDA's Cost Analysis Group provided analytical help to the Divisions with cost estimates they needed in connection with their analyses of effectiveness. The Group's professionals were trained to define and reduce the uncertainties in the cost data from past experience, to redress the effect of particular accounting methods, and to project the probable costs of new and untried system elements. The Group occasionally did some cost research as, for example, two studies some years ago analyzing the relative cost structures of Navy and civilian ship construction and comparing the costs of leasing and buying auxiliary ships for the Navy. The comparative cost studies directly assisted the Deputy Secretary of Defense in discussions with the Congress.

In recent years the increase in activities where cost predictions were far off the mark called for improvements in methods for both assessing and estimating the costs of defense

systems and forces. The need for improved understanding of cost/technology trends and the appropriate methodology to incorporate it—explicitly expressed by the Director, Program Analysis and Evaluation in OSD—stimulated the expansion of the Cost Analysis Group into the Cost Analysis and Research Division in July 1986. Support for the costing needs of other IDA Divisions continues, but now, in addition, IDA provides for the OSD a focused resource independent of involvements with hardware and with no special interests in particular systems, and having the unique ability to respect both classified and proprietary data while performing research to help assess and predict the costs of defense systems and forces more accurately.

Communications Research

Located in Princeton, New Jersey, the Communications Research Division (CRD) engages in mathematics research, and studies communications problems related to national security. Since its inception in 1958, the Division has emphasized mathematics and computer science in its research. In 1978 the program was augmented to address speech research. CRD maintains expertise in the design and development of systems and applications software in support of a supercomputer-based distributed computing environment. The professional staff comprises mathematicians in the majority, as well as computer scientists, electrical engineers, and speech scientists.

Supercomputing Research

Three decades of electronic computing, from the vacuum tube to integrated circuits on microchips, have brought vast increases in machine speed and capacity. But the potential for use of computers has more than kept pace. What must be developed now is a new mathematics for machine architecture and algorithms (and tests of their validity) from which can be formed the general rules on whose basis the software aspects, the computer languages, and the machine operational systems can be developed so as to take advantage of new computer technologies.

The DoD recognized its need for supercomputing research. Its decision to ask IDA to form the Supercomputing Research Center was based on IDA's track record as an institution that provides the kind of environment in which top quality scientists can work with each other on a profound intellectual problem,

from its most basic and generic aspects to its applications to defense needs.

The Supercomputing Research Center is in operation in temporary headquarters in Lanham, MD. Its permanent home will be nearby on a 14-acre site donated by the developers of the 466-acre University of Maryland Science and Technology Center, a research park. It is intended that a substantial amount of the work of the Supercomputing Research Center will be on unclassified basic research and the remainder on classified research dedicated to defense needs. The working environment—the ambience—is purposefully intended to attract an elite group of computer scientists, mathematicians, electrical engineers, physicists and others eager to explore a deeply interesting and difficult scientific mission.

In Sum

In direct response to stated needs of the Department of Defense, IDA largely works on national security strategy, on combat and combat support systems, on defense planning and management, and on research in areas of science, technology, and mathematics with broad application to national needs. IDA's work is put to use in evaluating systems, operations, and procedures, in validating military requirements, in adapting new technologies, in identifying military vulnerabilities and weaknesses, in improving efficiencies, in developing rationale for the allocation of resources, in developing, collecting, and integrating new ideas about national security, in identifying long-term issues, and in analyzing options for policy and budget.

Quality of product has always been our dominant objective. During its life, IDA has been able to enlist men and women of recognized eminence because the problems it deals with are of national importance and the way in which it deals with them is regarded with respect. We intend to continue this policy. In this report we can hope only to give the flavor of this work and a sense of its spread and its variety. In the decade we are covering, IDA has published over one thousand reports on its work, including documents designated, according to their level of detail and depth of review, as Reports, Studies, Papers, Memoranda, and Notes. The professional staff has published many papers and books in the open literature and given myriad briefings and lectures. These publications represent IDA's only physical product, and are the basis on which its influence is formed and

felt. In the following paragraphs we list some highlights of IDA's achievements on behalf of the DoD over the past decade. What follows is a selection of reports that the DoD found especially useful in each year shown. The continuity of effort in major program areas, as well as program evolution to meet new issues, becomes evident on perusal of these program details.

Program Highlights
1977

Alternate strategic force mixes. Study of potential performance of alternate strategic force mixes under the Vladivostok accords was widely briefed in DoD prior to Secretary of State's trip to Moscow in March 1977; subsequently briefed to House Armed Services Committee.

Strategic Arms Limitations Talks—support studies. Two broke new ground in extending consideration of the implications for SALT of so-called "gray area" systems; a third used as input to development of DoD position on the issue of limiting ICBM tests.

Conventional weapons options for NATO forces. Findings used as input to preparation of SecDef position papers that led to NATO New Initiatives program; also used by corresponding NATO Task Force to help determine antiarmor force level goals.

Air defense requirements. House Defense Appropriations Subcommittee requested that SecDef task IDA to conduct study; figured in Congressional, Defense Systems Acquisition Review Council (DSARC), and Service air defense planning and was subject of Congressional hearings.

Counter-countermeasures problems in tactical communications. Results of study stimulated action by the JCS and the Services to deal with enemy electronic countermeasures; contributed to formulation of policy on allocation of resources to attack jammers and to enhance antijam communications characteristics.

Navy and civilian shipyard costs. Two studies sent to the Congress and OMB by Deputy SecDef to help support his argument that the Navy should undertake new ship construction in its own yards.

AIMVAL/ACEVAL. IDA designed tests, monitored, and analyzed results of large-scale joint Air Force-Navy tests of short-range air-to-air missile characteristics (AIMVAL) and multiple air combat (ACEVAL). Results influenced choice of characteristics for new air-to-air missiles and some basic concepts of air-to-air combat.

1978

Strategic cruise missile program. Analyses of US capability to penetrate Soviet defenses led to tactical innovations; independent analyses of data emerging from on-going cruise missile survivability test and evaluation aided USDRE program oversight.

Pershing II and CAAM. Comparative cost-effectiveness analyses of Pershing II and cruise-missile-based Conventional Airfield Attack Munition (CAAM) figured strongly in DoD and Congressional efforts to determine future directions for these programs.

Joint tactical command and control. Program provided analytical assistance to Task Force 6 of the NATO Long-Term Defense Program in formulating a program to develop fusion centers. Analytical assistance also provided key inputs to the JINTACCS (joint interoperability of tactical command and control systems) working group on NATO interoperability standards.

CH-53E Super Stallion heavy lift helicopter. Analytic support provided to defense decision-makers as one of the main inputs to production decision.

Arms control impact statements. Technical assistance provided to DoD to help meet requirement in law for DoD evaluation of the entire spectrum of draft impact statements prepared by the Arms Control and Disarmament Agency.

US and Soviet R&D and system acquisition trends. Comparison of trends in US and Soviet R&D and system acquisition contributed to FY1980 posture statements of SecDef and Under Secretary of Defense Research and Engineering (USDRE).

Infrared devices and tactical forward-looking infrared (FLIR) systems. IDA studies aided in preparation of USDRE guidance paper for the Services; helped DARPA structure its program for developing new focal plane array technology; contributed to development of cooperative arrangements with NATO allies.

Quick reaction studies in support of acquisition decisions. Included independent evaluation of USAF tests of the British SKYFLASH air-to-air missile, and participation as a disinterested contributor to US Army evaluation of German 120mm tank gun for US Abrams tank.

1979

Chemical warfare. Study of relative effectiveness of US and Soviet forces in a chemical warfare (CW) environment aided in establishing requirements for US Army CW posture and in defining a field measurement program on troop performance under nuclear/biological/chemical warfare conditions.

NATO Identification System. Helped draw together US capabilities and define requirements for NATO-wide identification, friend, foe or neutral systems, command-control interactions in air combat, and planning for operational tests and evaluation in this area.

Fusion centers. Analyses of DoD activities directed toward creation of fusion centers, wherein diverse sensor data are fused into an intelligence picture, helped the DUSD/C^3I in responding to Congressional concerns in this area.

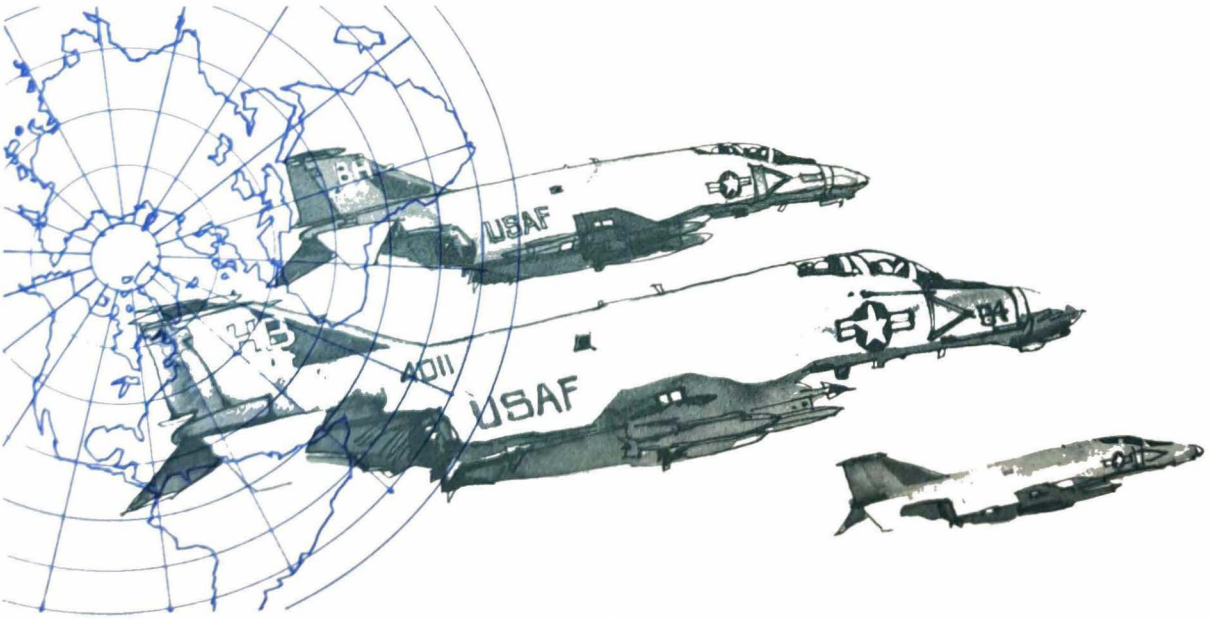
Improved Chaparral infrared-guided surface-to-air missile. Quick-reaction effort helped USDRE demonstrate to Congress how improved Chaparral system would compare with radar-guided Roland system [being adapted from the German design] under low-visibility conditions.

Significant technical contributions made in definition of advanced technology programs in the areas of **very high speed integrated circuits (VHSIC), advanced propulsion systems, and related materials programs.**

National Communications System (NCS). Analysis identified problems and stimulated action to correct them in post-attack priority communication restoral and reconstitution procedures.

Defense-wide management problems. IDA studies made significant contributions to resolution of management problems in the areas of competitive system acquisition, the ammunition production base, AUTODIN user charges, and technology export control.

Air defense requirements. Ongoing analyses continued to be a source of ideas and guidance in such areas as the US Army's high-medium altitude surface-to-air missile (SAM) mix for Europe; NATO air defense planning; comparison of Improved Hawk (I-Hawk) and Roland for airbase defense; and USAF measures to reduce the vulnerability of AWACS.



1980

Advanced medium range air-to-air missile (AMRAAM). IDA analyses were used by Principal Deputy USDRE to ensure that the Services gave adequate attention to potential effects of enemy electronic countermeasures on the missile's capability.

DoD field testing of C-5A operation on hasty airfields. Analysis undertaken in connection with study of the Rapid Deployment Force indicated desirability of extending ongoing tests to encompass wet-season conditions.

SSBN vulnerability. Analyses helped devise a scheme to eliminate radar detectability of the very low frequency trailing-wire antenna for communications with nuclear-powered ballistic missile submarines; IDA was then at the focus of detailed DARPA/Navy feasibility study of the technique.

North American Air Defense Command. An approach to elimination of early-warning false alarms, a problem that had plagued the Command, emerged from an IDA analysis of the problem and was implemented by the DoD.

Air-to-ground coordination and integration of ground fire systems. Studies of various aspects of tactical command and control helped reconcile Service and other NATO nations' systems; helped DoD assess and rationalize its tactical fusion center program.

Militarily Critical Technologies List (MCTL). As the major contributor to the DoD's preparation of the MCTL, required by the 1979 Export Administration Act, IDA assembled appropriate industry and government experts and conducted the technology review that led to creation of the list.

1981

Cost-effectiveness of training technology. Results of analyses were used by OSD and the Services to establish policy on maintenance training simulators.

Arms cooperation and trade among NATO nations. Results used by US officials in NATO to help in their negotiations with European allies.

Navy shipbuilding potential for the DoD. Study for the SecDef, undertaken by IDA at his request in response to a Congressional inquiry on the subject; was forwarded to the four Congressional Armed Forces Committees.

Interaction between readiness and system complexity. Contributed to a Defense Science Board (DSB) review of the problem for the SecDef.

Joint tactical command and control. IDA analyses provided the basis for agreements between US and other NATO nations on requirements for a ground fire coordination system.

DoD automated data processing system acquisition. Policy paper prepared for the USDRE was used in his testimony to the Congress.

Defense satellite communications system. Areas for ground-based reliability testing and improvement of the system were identified as a substitute for "in-orbit tests before production decision," which had proven infeasible.

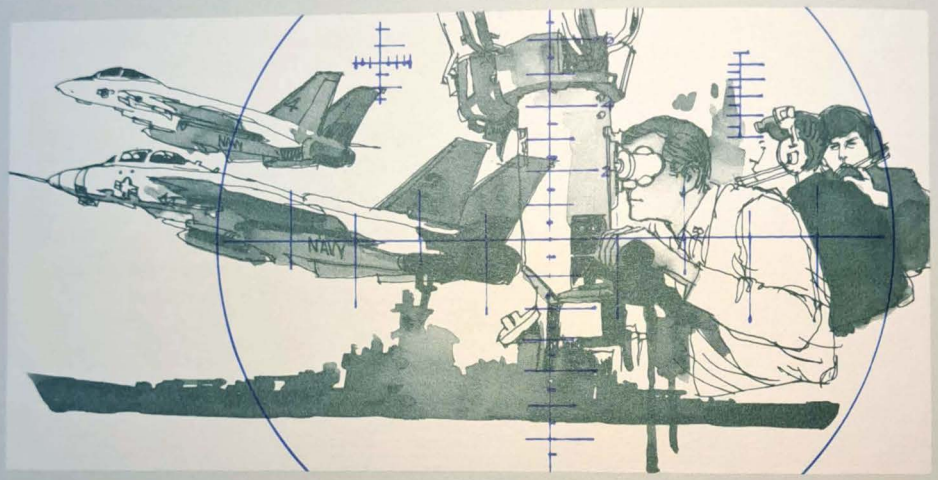
Command, control and communications system for the Rapid Deployment Force. Helped develop near-term architecture to link together DoD communication satellites and terminals for RDF C^3 system.

Militarily Critical Technologies List. Continued assistance to DoD in preparing, updating, and refining a rationale for items placed on the MCTL.

1982

Air defense of the NATO Central Region. Study of technical aspects of a major DoD initiative to modernize NATO Central Region air defense to counter new Soviet force developments served as a key input to discussions among the responsible NATO and national planning bodies.

Service acquisition of tactical aircraft and weapons. Two reports, one on new technological capabilities for the conventional defense of NATO, one on the long-term plans for such defense, served as major inputs for reports requested of the SecDef by the Congress.



Naval force structure planning. Results of studies of alternate forces for sea control missions helped OSD foster cooperative agreements between the Navy and the Air Force toward joint operations.

Studies of command and control architectures for airspace control and ground force operations in Europe became the basis for NATO planning in these areas.

Analyses of alternatives to the planned AUTODIN II data transmission network were used by DoD in the decision to implement a new Defense Data Network and cancel the originally planned system at considerable cost reduction and reduced vulnerability.

1983

Nuclear forces in Europe. Analyses showed that, within a wide range of scenarios, the only theater nuclear forces with unique military value for NATO are those with the potential to destroy Warsaw Pact maneuver units on the battlefield; study widely briefed and interacted with formulation of US positions on the Intermediate Range Nuclear Force (INF) in Europe.

Advanced medium range air-to-air missile (AMRAAM) operational utility evaluation. Was influential in establishing the utility of man-in-the-loop simulators to evaluate new concepts for air-to-air missiles.

High acceleration ballistic missiles. Showed that such missiles appear feasible with existing propulsion technology and that they may have advantages in future deployment concepts. [This review of "fast-burn boosters" was later reflected in system discussions of concern to the Strategic Defense Initiative.]

Alternative space shuttle upper stages to boost military satellites into geostationary orbit. Study concluded that new concepts for integral propulsion systems could save as much as $200M in deploying MILSTAR communication satellite; formed the basis of a DoD Inspector General report recommending reassessment of [then] current plans.

Overhead costs in defense industries. Concluded that lower overhead cost is not necessarily better, since different companies use different "overhead" definitions; total cost, which may be lower in highly mechanized, productive plants, is a more important measure of cost saving. Research affected DoD approach to cost category interpretation.

European Theater air command and control. Study of intelligence and sensor data, selected data links, voice communications and identification, friend/foe systems led to a list of revisions in the NATO Air Defense Planning Group plan for air command and control improvements.

Cruise missile survivability. Quantified the characteristics of future cruise missile configurations that would be needed to ensure effective penetration of projected Soviet air defenses.

Lessons learned from the Falklands conflict. Review for SecDef created an extremely valuable data base on the subject, reinforced the importance of leadership, selection, quality, and training of personnel, and stimulated several Service and Defense

Agency actions, including Army consideration of a field evaluation of Rapier, the British short-range air defense missile used in the war.

NATO land operations in the year 2000. Through participation on a panel in the NATO Defense Research Group, IDA contributed an important document to the NATO weapons planning process and NATO's continuing efforts toward exploitation of "emerging technologies."

Low cost conventional cruise missiles. Quick-reaction effort for the Assistant Under Secretary of Defense (Plans and Development) examined low cost approaches to cruise missile design and what requirement tradeoffs could buy in terms of military capability and led to discarding of plans for a particular missile as being impractical.

Space defense countermeasures capabilities. Analyses showed how certain countermeasures could adversely affect the performance of both present Soviet and planned US space defense systems; affected future space defense systems plans.

1984

NATO defense requirements. Developed an integrated conceptual framework and evaluated many concepts and systems to meet requirements articulated by the Supreme Allied Commander, Europe (SACEUR) and NATO Defense Ministers; further, devised ways of using emerging technologies to meet those requirements in gaining air superiority and attacking Warsaw Pact follow-on forces.

Anti-armor master plan. Provided technical inputs and analyses to the DoD to assist in developing master plan requested by Congress.

Software Technology for Adaptable, Reliable Systems (STARS). Provided technical assistance, analyses, and support toward refining the STARS program plan in response to a perceived need to integrate new software technology more rapidly into DoD systems.

Chemical munitions. Designed a stockpile of chemical munitions that satisfied the requirements of chemical deterrence; identified preferable modes of chemical weapons development.

Critical materials. Analysis of DoD's ability to deliver items using critical, strategic, or high technology materials led to revisions in priority allocation manuals and some industry reassessment of their positions with respect to dependence on foreign sources.

Navy operating and support costs. Methodology developed to predict these costs, in the aggregate, as a function of physical characteristics of naval forces (numbers and types of ships, aircraft, etc.) was used by OSD in the program and budget review process to judge the reasonableness of Service operation and maintenance cost submissions.

Technical management of technology-base programs. Research on infrared, electro-optics, tribology, remote sensing, cloud and dust phenomenology, and other technology-base areas was used by various defense agencies to assist in technical management of a large diversity of technology-base programs.

Materials research. IDA work as the focal point for technical information in this area assisted DoD in research program formulation, including a new area concerning materials with SDI applications.

Alternative strategic environments for the years 1994-2004. A projection of alternative strategic environments was developed for OJCS; these projections have been used extensively in preparation of Joint Long Range Strategic Appraisal by the Joint Staff.

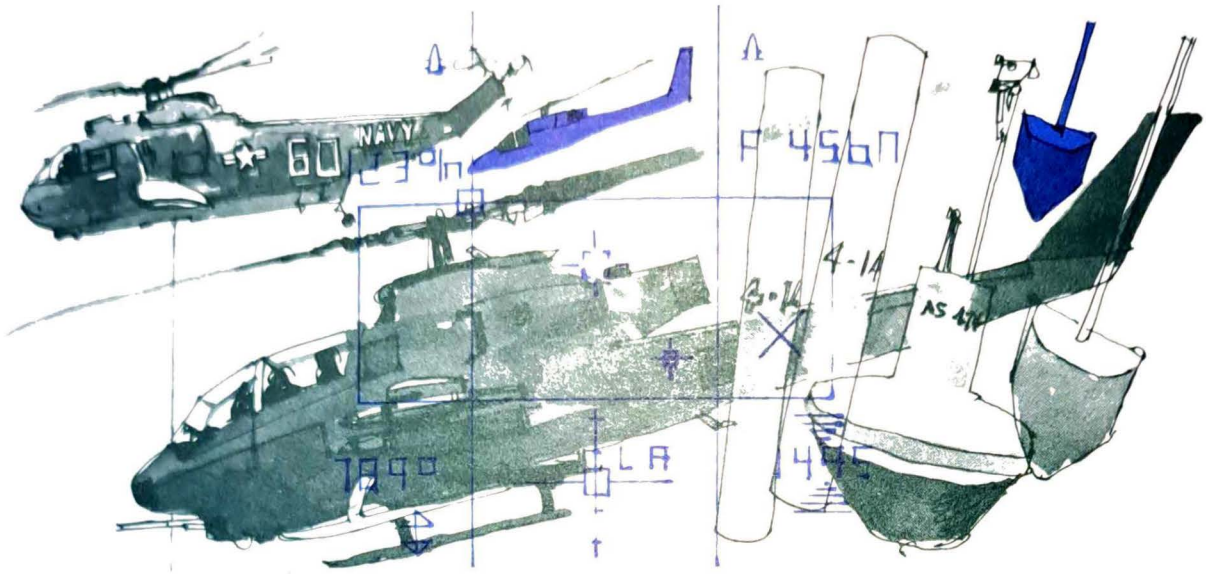
Cost-effectiveness of defense training technology. Research results enabled OSD to provide guidance to Service programs and assisted OSD in their response to the Congress answering questions about development and acquisition of training devices and simulators.

Weapons systems programs and budgets. Contributed technical support to OSD development of programs and budgets with respect to antitactical missile, air defense, and airbase attack systems for use by NATO in the European Central Region.

Support of DoD in COCOM negotiations. Helped in the achievement of multilateral controls on about 75 new critical products and technologies, including computer hardware and software.

1985

Computer-aided logistics support. Research program provided the basis for a broad expression of DoD policy, expressed in a letter from Deputy Secretary Taft to the military departments and defense agencies.



Scout helicopter procurement program. Helped resolve differences between OSD and the Army over scout helicopter procurement programs by showing the potential effectiveness of alternative scout/attack mixes in combat situations.

Security of military contingency operations. Work on preserving security in military contingency operations led to a manual for military staff operations planners that has been disseminated in several thousand copies.

Security of command and control data bases. Study of requirements for the Joint Tactical Command, Control and Communications Agency led to a new security configuration, at substantial cost savings.

Weapon system performance requirements, costs, and schedules. Technical support of a Defense Science Board task force, in a study of case histories of weapon system performance requirements, costs, and schedules, set the stage for informed discussion of the ways in which the requirements process has driven system acquisition management and costs.

US Army tactical command and control system. Independent review of US Army tactical command and control

system plans showed conflicts and missed connections among five activities that were supposed to be interrelated; helped the Army focus the planning for its new activity.

Joint Tactical Information Distribution System. Joint study with MITRE of options for consolidating JTIDS program led to further internal review by the Navy and their subsequent decision to join the Air Force TDMA program (a time division multiple access jam-resistant communications program).

1986

Fire support system. Independent assessment of two different automated fire support systems being developed by the Army and Marine Corps helped OSD sponsors, ASDC^{3}I and Deputy Under Secretary of Defense (DUSD) (Tactical Warfare Programs) present a proposed consolidation to the SecDef that should save substantial investment costs while providing both Services with a common, highly effective system.

JCS Forces Planning Program. At the request of OJCS, a set of models for rapid assessment of costs and effectiveness of alternative force postures was developed and is being used by OJCS to help it respond to broader responsibilities assigned under recent legislation. The models will soon come into use, in revised form, by other parts of the DoD.

Third-generation night vision devices. Review and critique of third-generation night vision devices led to a decision by Under Secretary of the Army to delay procurement pending resolution of issues raised by the study.

Alternative Navy missile systems for fleet air defense. A study of the costs and potential combat effectiveness of alternative Navy missile systems for fleet air defense suggested the potentially most effective mixes for various investments; helped OSD and the Navy in reaching agreement and decisions on a missile and sensor mix for future fleet air defense programs.

Host nation telecommunications systems. Work on the potential utility of host nation telecommunications systems in the Central Command area of responsibility became the baseline input for the design of a theater-level communications system.

Joint Tactical Information Distribution System (JTIDS). Assessment of test plans for the JTIDS led to modifications of the

plans, including incorporation of factors affecting multi-Service issues and improvement of the test environment and test criteria.

Alternative continental air defense postures. Research on alternative continental air defense postures to complement ballistic missile defenses was used by the Office of the Director, Program Analysis and Evaluation, in planning the new Air Defense Initiative research program.

Worldwide Military Command and Control System Information System (WIS). Identified required foundation software technology for the WIS, including technical specifications for prototype software development efforts; developed technical specifications for IDA-designed Ada/ database management system interface. This work, for the WIS Joint Program Management Office, has essentially become a DoD standard for WIS application software.

Defense Science Study Group. In conjunction with DARPA, hosted a group of 13 of the foremost scientists and engineers in the country to engage the interest and support of a new generation in defense matters.

Strategic Defense Initiative. A review of the effect on space-based kinetic energy weapon (KEW) system performance that could be achieved by certain ballistic missile system countermeasures, such as fast burn time and deceptive actions to cause delay in KEW launch, contributed to requirement definition for a sturdy SDI system design.

Industrial production of military material. An assessment of possible ways to accelerate the rate of production of the M-1 Abrams tank and M-2 Bradley fighting vehicle under crisis conditions warranting a surge in industrial production of military material, showed how such armored fighting vehicles would have to be designed to facilitate rapid production increases.

LOOKING TO THE FUTURE

IDA plans to continue building on its experience, its professional skill, and its adaptability to satisfy Defense needs and to contribute to their definition. Some of its work areas will fade, some will change, new work will emerge. We foresee a national security environment into the early nineties of continuing US/Soviet competition, continuing US-NATO/USSR-Warsaw Pact arms and arms control interactions, turmoil and terrorism in many areas, hotspots in the Middle East, Central America, Afghanistan, Southern Africa—and an occasional surprise. We foresee continuing increase in the importance of the Pacific Basin in US national security concerns, as well as improving relations with China. There will be economic competition among Western Allies, Japan and other Western Pacific nations with consequent stresses and technological impact from computing, biotechnology, and robotics. There will be continuing defense budget sensitivity and possible further defense reorganization.

Among the major defense issues that we believe IDA will be involved with are those having to do with the nation's technology and mobilization base, strategic weapons, nuclear and chemical weapons, conventional systems improvements, manpower and its utilization. We believe IDA also will explore issues involving the exploitation of modern electronics and computers and, importantly, issues concerning major management problems such as controlling technology-driven costs and acquisition reform, among others. Finally, IDA will be concerned with matters of broad national policy and national strategy and the many issues such matters raise.

Areas of increasing emphasis in technology should include research on advanced technologies such as affordable precision-guided munitions, directed-energy weapons, robotics, ultra-large scale integrated circuits, computers, artificial intelligence, systems engineering, and improved man-machine integration, as well as the policy issues of what to do about the declining

national technology base in relation to national security.

IDA intends to persist in its purpose of performing a public service by bringing scientific and scholarly expertise to bear on problems of national security, to act as a bridge between the academic world and defense requirements, and to provide an atmosphere for this work that will attract the best minds to this opportunity for national service.

COLLATERAL ACTIVITIES, PRIZES, AND AWARDS

The Institute, since its founding, has used its discretionary funds to support self-initiated research because we believe this work contributes to defense interests over the long term. By supporting such non-directed research, IDA encourages its staff to investigate otherwise high-risk offshoots of its sponsored research, to conduct promising methodological research with no immediately apparent application, and to explore relevant byways of history to better inform our research on contemporary issues.

During the period of this report, the IDA Central Research Program has funded many varied and valuable studies. For example, the combat capabilities of alternative aircraft carrier designs have been much analyzed, but force structure comparisons, such as the projection of presence, are less often quantified. A central research task undertaken in 1982 presented the results of evaluating equal cost forces of alternative carrier designs in the "presence" role. A study undertaken in 1985 proposed a new laser diagnostic technique for determining the mass of bodies in space, utilizing laser-Doppler measurements to determine the small velocity changes that are produced by momentum transfer from laser pulses to absorbing and/or reflecting objects. A study conducted in 1986 addressed the broad issue of DoD's need for qualified personnel with the expertise to evaluate courses in the Ada programming language. In a completely different vein, research was conducted and a paper presented documenting the schedule and cost growth of major DoD weapon system acquisition programs that have attained Initial Operational Capability, and a study was performed to ascertain the historical conditions under which fighting units have maintained their effectiveness in the face of combat losses. Also, models were built to study simulated conflicts such as those implied by the SDI, to illuminate the policy issues involved. Over the period of this report, over sixty Central Research Program studies have been conducted.

IDA has also continued its long-established practice of encouraging staff to further their professional development by supporting participation in the activities of professional societies and encouraging publication in the open professional literature. It offers to selected staff full or partial financial support for academic course work, research, teaching, and related activities. A rich variety of seminars are offered during the year, bringing to IDA those men and women who are at the forefront of their fields to enrich the knowledge base of the staff.

Public recognition of work performed by members of the staff during the years covered by this report include the award in 1984 of the valued Secretary of Defense Medal for Outstanding Public Service to Dr. Ronald A. Finkler for his work over twenty years in contributing to control of the export of critical technologies. Dr. Jeffrey H. Grotte, Dr. Ray H. Jakobovits, and Eleanor L. Schwartz (with Joseph S. Domin, Consultant) were honored by the award for Best Paper of 1983 by the *Journal of Defense Research* for their contribution on "Maritime Nuclear War and Naval Force Structure Considerations." IDA awards for excellence in research, established by then IDA President Goodpaster early in 1984 to be given each year for outstanding work contributing to national security, were won for 1983 by Dr. Hans Wolfhard for his work in the phenomenology of aircraft and missile detection, by Dr. Phillip Gould in 1984 for his work in the JCS Forces Planning Program and the NATO Counterair Study, and by Dr. Lowell Bruce Anderson in 1985 for his work in creating large scale computer simulations of warfare to analyze many strategic and tactical issues. The award for 1986 was shared by Dr. Ernest A. Seglie and Dr. L. Dean Simmons. Dr. Seglie was recognized for his extraordinary support to the Director of Operational Test and Evaluation in the testing of the Army's Division Air Defense (DIVAD) system. Dr. Simmons distinguished himself by leading a study related to fleet air defenses that employed a particularly imaginative and illuminating methodology for identifying the most cost-effective combinations of fleet air defense systems, and that significantly influenced the choices of systems for development. This annual award, which carries with it a commendation and cash prize, was named by IDA President Smith in 1986 "The Andrew J. Goodpaster Award for Excellence in Research" in recognition of General Goodpaster's many contributions to IDA.

MANAGEMENT

Trustees

IDA is a nonprofit membership corporation established under the laws of Delaware. The Members, of whom at least one-third must be drawn from the academic community and one-third from public life, are elected for three-year terms.

The Board of Trustees, elected by the Members, provides basic policy guidance to the Management of IDA and is responsible for the funds of the Corporation. The Board comprises the Trustees and the President of IDA. The Trustees elect an Executive Committee that is empowered to act for the Trustees between meetings of the full Board.

The Honorable William A. M. Burden, Chairman of the Board since 1959, retired in 1981. Mr. Burden passed away in 1984. His long and devoted service to the proper role and functioning of IDA had much to do with IDA's strength today.

Mr. Burden was succeeded by Dr. Eric A. Walker, a highly valued and active Trustee since 1959. Dr. Walker ably guided IDA through the adjustments occasioned by the DoD review of 1982, retiring in 1986. He remains involved in IDA activities, and now serves as Chairman Emeritus. He was succeeded by the Hon. Robert F. Froehlke, a Trustee since 1974. The composition of the Board in 1986 (listed by the date that the Trustee's term expires), its Executive and other Committees, Officers, Senior Staff, and a list of former Trustees who have served, is displayed in the pages following.

Board of Trustees
October 1986

Robert F. Froehlke, Chairman
Eric A. Walker, Chairman Emeritus
Herbert E. Longenecker, Vice Chairman
Louis W. Tordella, Vice Chairman

1987

Noel Gayler, Public Trustee
W. Jarvis Moody, Public Trustee
Harrison Shull, Academic Trustee
Louis W. Tordella, Public Trustee
Eric A. Walker, Academic Trustee
Herbert F. York, Academic Trustee
William Y. Smith, Public Trustee

1988

Daniel Alpert, Academic Trustee
Donald V. Bennett, Public Trustee
Ruth M. Davis, Public Trustee
Robert F. Froehlke, Public Trustee
George P. Gardner, Jr., Public Trustee
Andrew J. Goodpaster, Public Trustee
Samuel P. Huntington, Academic Trustee
Herbert E. Longenecker, Academic Trustee
John W. Tukey, Academic Trustee

1989

Russell E. Dougherty, Public Trustee
Jack L. Kerrebrock, Academic Trustee
Marx Leva, Public Trustee
Stephen R. Petschek, Public Trustee
Stanley R. Resor, Public Trustee
Robert L. Sproull, Academic Trustee

Executive Committee

Robert F. Froehlke, Chairman
Herbert E. Longenecker
Louis W. Tordella
Daniel Alpert
Andrew J. Goodpaster
Marx Leva
W. Jarvis Moody
William Y. Smith
Herbert F. York

Visiting Committee

Herbert E. Longenecker, Chairman
Daniel Alpert
Donald V. Bennett
Noel Gayler
Louis V. Tordella

Finance and Audit Committee

W. Jarvis Moody, Chairman
Robert F. Froehlke, Vice-Chairman
George P. Gardner, Jr.
Marx Leva
Stephen R. Petschek

General Counsel: Leva, Hawes, Mason & Martin
Auditors: Coopers & Lybrand

Officers
October 1986

William Y. Smith, President
Seymour J. Deitchman, Vice President-Programs
Frederick G. Latreille, Vice President-Administration and Finance and Corporate Secretary
Robert B. Pirie, Jr., Vice President-Planning and Evaluation
Arthur W. Boysen, Treasurer
Mary A. Grosscope, Assistant Secretary
Michael B. Sheppard, Assistant Secretary

Former Members Board of Trustees

A. Adrian Albert[+]
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Robert C. Baker[+]
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Jack P. Ruina
Frederick Seitz*
Charles M. Spofford
Chauncey Starr
Maxwell D. Taylor*[+]
Frederick E. Terman[+]
Charles H. Townes
Frederick T. Wall

[+] Deceased
*Served during the period of this report.

Corporate Officers

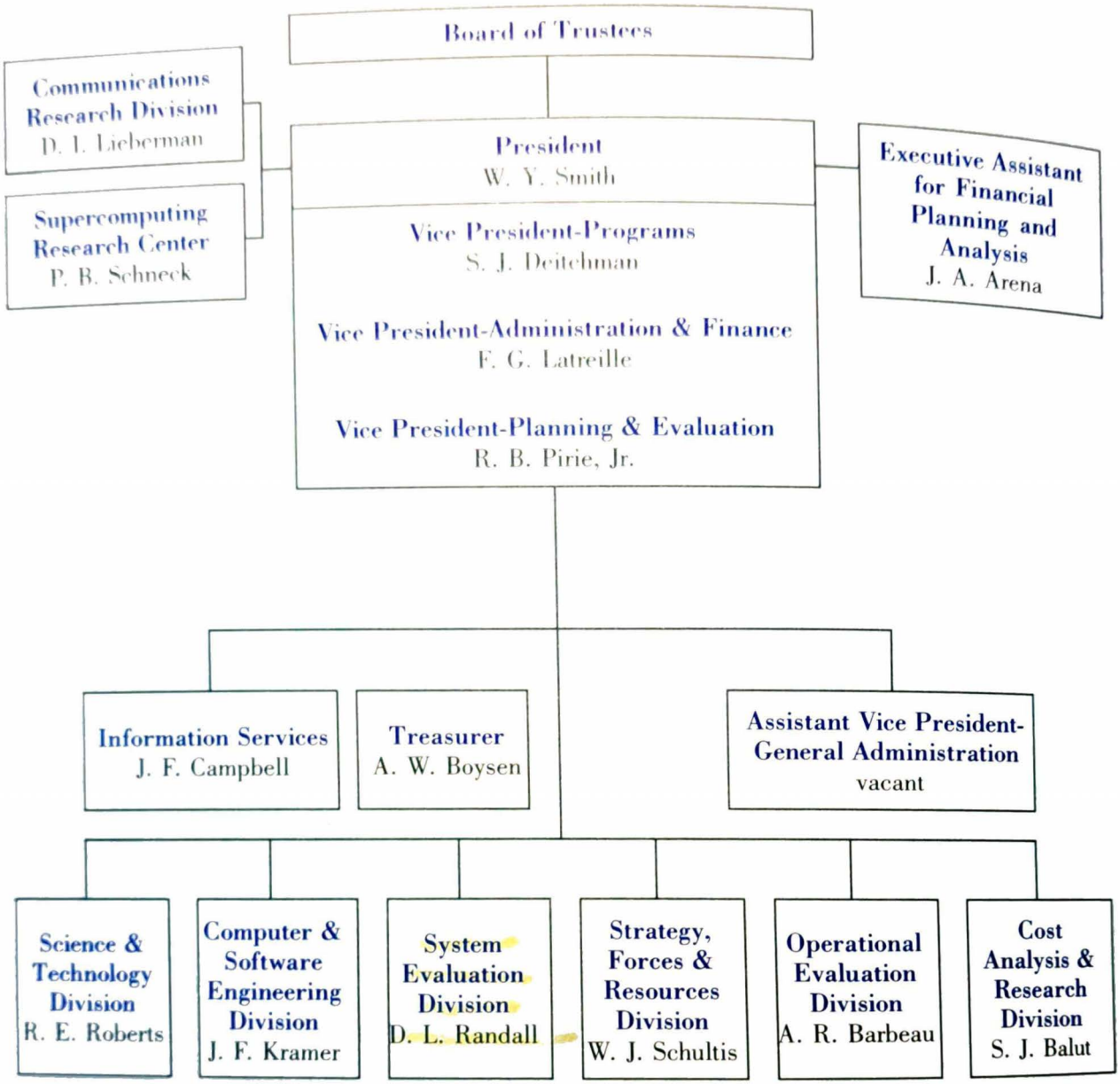
General William Y. Smith, USAF (Ret.) assumed the Presidency of IDA in October 1985 after a long and distinguished career in the United States Air Force. He succeeded General Andrew J. Goodpaster, USA (Ret.) who had agreed to serve for two years after Dr. Alexander H. Flax retired in October 1983 after 14 years as President. Dr. Flax remains associated with the Institute as President Emeritus. General Goodpaster continues to serve on the Board of Trustees as a Public Member.

A major management trend over the years of this report period has been toward more directly planned program integration and task formulation and toward coordination of the multiple relationships of IDA's Divisions with IDA's sponsors. Toward this end, in March 1977, the post of Vice President for Planning and Evaluation was established. It was filled by Mr. Seymour J. Deitchman who became Vice President-Programs in October 1983 with direct responsibility for research program oversight in the Virginia operations. To assist him, Mr. Robert B. Pirie was appointed in 1983 to the newly established post of Assistant Vice President for Program Development and Review. On 16 October 1986, Mr. Pirie was elevated to the Post of Vice President-Planning and Evaluation.* Although not a corporate officer, Mr. Joseph Arena was named Executive Assistant for Financial Planning and Analysis in 1986 to fulfill these functions on behalf of the Corporation.

Mr. Richard F. Ottman was Vice President-General Manager from 1969 to 1983. When he left IDA his functions were taken over by Mr. Frederick G. Latreille who had been serving as Vice President-Deputy General Manager as well as Corporate Secretary. Mr. Latreille has been Vice President-Administration and Finance since 1983 and Corporate Secretary since the middle 1970s. Mr. Arthur W. Boysen, Assistant Treasurer since 1967, has served as Treasurer since 1978. Mrs. Mary A. Grosscope has been an Assistant Secretary since 1977, and Mr. Michael B. Sheppard, Esquire, of IDA's General Counsel's Office, was elected an Assistant Secretary in 1986.

*Mr. Pirie left IDA to become the Chief Operating Officer of a private corporation in January 1987, shortly after the period covered by this report.

INSTITUTE FOR DEFENSE ANALYSES*



*Organization as of 31 December 1986

Division Management, 1986*

Science and Technology
Robert E. Roberts, Director
Ronald E. Finkler, Deputy Director
Marta L. Kowalczyk, Assistant Director
John E. Hove, Assistant Director
Ostap S. Kosovych, Assistant Director

Computer and Software Engineering
John F. Kramer, Director
John Salasin, Deputy Director
Robert I. Winner, Deputy Director

System Evaluation
David L. Randall, Director
Phillip Gould, Assistant Director
Richard J. Ivanetich, Assistant Director

Strategy, Forces and Resources
William J. Schultis, Director
Jeffrey H. Grotte, Deputy Director
Victor Utgoff, Deputy Director
Edward P. Kerlin, Assistant Director
David R. Graham, Assistant Director

Operational Evaluation
Andre R. Barbeau, Director
Irwin A. Kaufman, Assistant Director
William B. Buchanan, Assistant Director

Cost Analysis and Research
Stephen J. Balut, Director
K. M. Olver, Deputy Director
J. Richard Nelson, Assistant Director

*Over the period of this report, Division organization has evolved to reflect the management leadership as above. In the order of presentation, Division leadership evolved as follows: SED, Andre R. Barbeau, 1972-1984; OED, established 1984; STD, Robert H. Fox, 1967-1983; SF&RD, Harry Williams, PAD, 1974-1984, ISSD/ISAD, William J. Schultis, 1979-1984; CSED, Thomas H. Probert, 1983-1986; CARD, Norman J. Asher, CAG, 1978-1985, James McCullough, 1968-1978; CRD, Lee Neuwirth, 1977-1985; SRC, established 1985.

Communications Research
David I. Lieberman, Director
Nicholas J. Patterson, Deputy Director

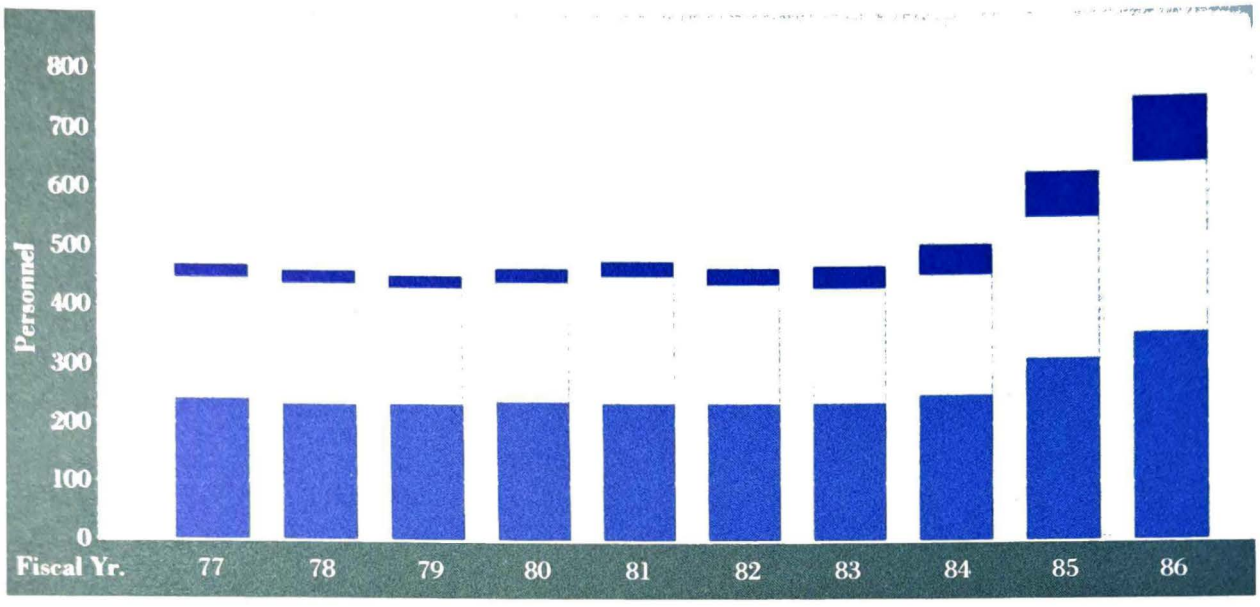
Supercomputing Research Center
Paul B. Schneck, Director
Harlow Freitag, Deputy Director
Alfred Brenner, Assistant Director
Michael J. Kascic, Assistant Director
John P. Riganati, Assistant Director

Staff and Staffing

The size of the IDA staff remained essentially constant over the first eight years of our reporting period. Recently the research staff has increased in response to the Defense build-up and the new DoD needs discussed earlier, particularly in the computer and SDI areas. The histogram shows total staff over this period.

Since its inception, IDA has called upon consultants for their special expertise. This course has provided IDA with the essential flexibility to meet changing needs across a variety of technologies without unnecessarily increasing the size of the permanent staff. Additionally, in the recent past IDA has assumed a number of unique tasks—such as development and maintenance of the congressionally required Militarily Critical Technologies List—that depend primarily for their preparation on organizing expert contributions over an exceptionally broad range of advanced technologies. In the course of this work, IDA has undertaken related management activities for certain OSD and Defense Agency offices which necessitated the letting of subcontracts for the performance of specific technical tasks. The number of consultants has grown correspondingly to meet these sponsors' needs.

STAFFING EFFORT



*Equivalent Man Years Shown

ADMINISTRATION AND SUPPORT

The goal of any administrative element is to help provide for the smooth functioning of the primary business of the organization it serves. Such a goal is made more difficult when the public trust is involved. For example, IDA must maintain the elaborate control and accountability of public funds and of classified documents that are required of Defense contractors, while at the same time freeing the creative energies of its staff by burdening them with as few administrative procedures as possible.

IDA has met its public and institutional responsibilities due in part to the quality of service offered by its administrative and support staff. Collectively they strive to ease and enrich the work of the research staff with the services they provide, including Information Services, Personnel, Administrative Services, Finance and Accounting, the Library, Computer Services, Security, Purchasing and Publications Services.

Information Services

In 1983, with encouragement and support from the Trustees, IDA began a major modernization of its computer systems as part of the larger goal of bringing the power of modern computing technology to bear on the research problems it faces. This has been an ambitious program. The goal—to provide appropriate IDA staff with desk-top computer capability—is being met. Each research staff member now has the computing capability to handle large models in an interactive environment, and to develop, maintain and manipulate large data bases as a matter of course. This evolution has seen a single CDC-6400, which could operate only in the batch mode, replaced by large-capacity DEC VAX 785 and 8600 minicomputers and desk-top terminals, augmented by Apple Macintosh and IBM and IBM-compatible

Personnel

The Personnel Directorate under Mr. Martin Burns administers the employment, compensation, benefits, career development, consultant acquisition, and employee welfare and morale programs of the Institute. Mr. Burns assumed direction of Personnel in 1986 following the retirement of Mr. Kenneth Dolan after 22 years of service in the position.

Of particular interest to the IDA staff is the benefits program. Always strong, the benefits program has continually improved over the past ten years. Health Maintenance Organization (HMO) medical plans were added to the existing medical insurance program in 1976; total disability insurance benefits were increased and the disability insurance eligibility age extended in 1979; and a dental insurance plan added in 1980. Since its inception, the Institute has offered an excellent retirement plan. In 1980 IDA increased its contribution from 9 percent of annual salary to 11 percent of annual salary, and in 1986 converted to a "qualified" retirement plan, allowing employees to contribute substantially more to the IDA tax-deferred annuity plan.

Administrative Services

The Directorate of Administration under Mr. Arthur Davis, manages the Security, Purchasing, and Administrative Services Offices of the Institute. IDA Security concerns itself with all aspects of physical security of the buildings and offices, with accountability for and maintenance of control of classified material borrowed or produced, and with processing security clearances of staff and visitors. The Purchasing Office, in addition to carrying out the office furnishing and supply function, interacts with IDA' s vendors, including the leasing and purchase of computers and associated peripheral equipment. Valuable courier services and shuttle services among IDA, the Pentagon, and other facilities are provided by the Administrative Services Office. Additionally, "Admin" assists in meeting planning, conference room scheduling, and provision of audio-visual equipments for meetings and seminars, among other services.

Facilities Management

The increasing sophistication of technology and the resultant demands for more specialized and exacting solutions to more specialized and exacting defense problems have spurred the

growth of the IDA staff and the need for facilities adequate to house them. For 18 years IDA was located at 400 Army-Navy Drive, Arlington, Virginia, in a building within walking distance of the Pentagon. During the early 1980s IDA moved to its present facilities. Again giving thought to the environment in which the staff works, IDA's headquarters and main research facility was built on the edge of a forested site at 1801 N. Beauregard Street, Alexandria, Virginia. The Communications Research Division remains in Princeton, New Jersey, and the new Supercomputing Research Center will soon move into permanent facilities at the University of Maryland Science and Technology Center in Bowie, Maryland.

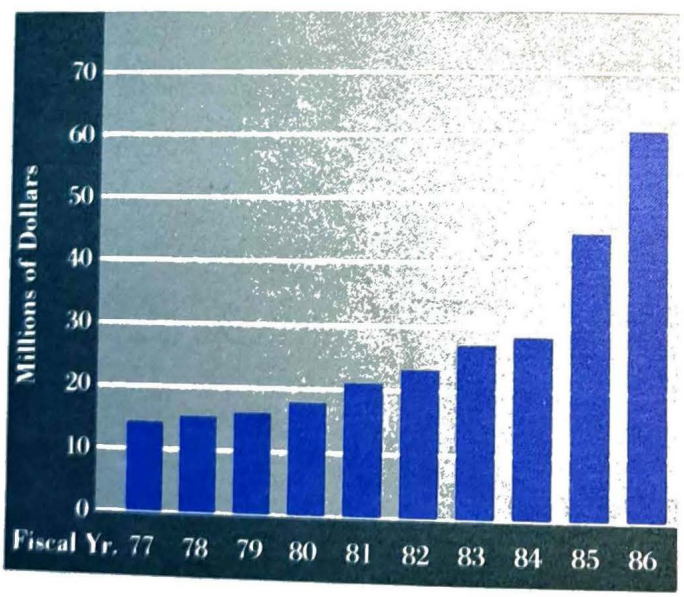
Finance

The financial and accounting functions are administered under the able leadership of Arthur W. Boysen, Treasurer. Those areas under his supervision comprise Budgeting and Finance, which includes budgeting, programming and financial reporting, development of financial systems, and coordination of all computer requirements within the Accounting Department; Accounting, which includes maintenance of records, preparation and filing of various government agency reports, interaction with DCAA and outside auditors, and submission of billings and other financial reports; Internal Auditing, which includes the processing of vouchers, travel advances, invoices, relocation claims, and various internal control reviews; Subcontracts Administration, which includes requests for proposals, preparation of authorization requests to the Contracting Officer, and administration of subcontracts for all Divisions. The Treasurer also attends to all financial reporting to the Board of Trustees, including the Finance and Audit committee and other members of IDA management; safeguarding and investment of funds; maintenance of insurance policies; and preparation of contract proposals, negotiation and review, and signing of contracts.

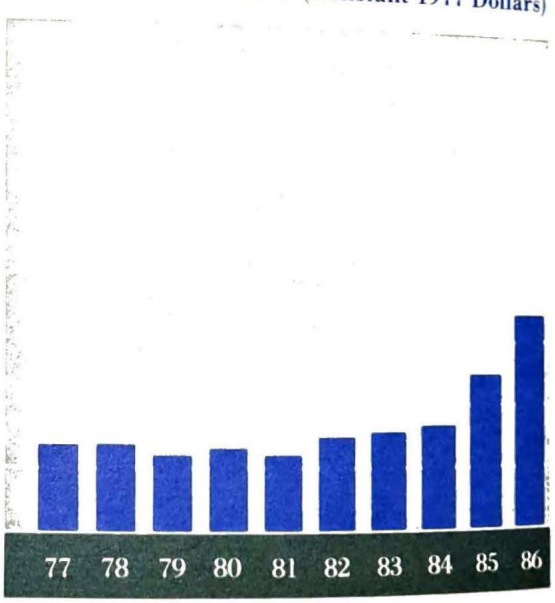
FINANCE: A TEN YEAR SUMMARY

The following graphs show the history of IDA's revenues over the ten year period ending September 30, 1986. The increase of revenue over the recent years is due to a combination of factors. Some were derived from inflation. Most were derived from the establishment of new divisions such as the Supercomputing Research Center and the Computer and Software Engineering Division, and from work to meet new DoD needs associated with the Strategic Defense Initiative, software engineering, export control, and expanded operational test and evaluation.

TOTAL REVENUE (Current Dollars)



TOTAL REVENUE (Constant 1977 Dollars)



Coopers & Lybrand

The Board of Trustees
Institute for Defense Analyses

We have examined the balance sheets of the Institute for Defense Analyses (the Institute) as of September 30, 1986 and 1985, and the related statements of revenue and expense and change in general reserve for the years then ended. Our examinations were made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the financial statements referred to above present fairly the financial position of the Institute for Defense Analyses as of September 30, 1986 and 1985, and the results of its operations for the years then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

Coopers & Lybrand

1800 M Street, N.W.
Washington, D.C. 20036
December 12, 1986

INSTITUTE FOR DEFENSE ANALYSES
BALANCE SHEETS

September 30, 1986 and 1985

	1986	1985
ASSETS		
Cash	$ 141,288	$ 74,342
Accounts receivable (Notes 2, 3 and 9)	11,156,485	7,238,628
Prepaid expenses	456,828	203,940
Fixed assets, net (Notes 1, 4 and 10)	3,026,903	3,219,602
Other assets (Notes 5 and 10)	1,203,866	1,324,388
	$15,985,370	$12,060,900
LIABILITIES		
Accounts payable and accrued expenses	$ 3,746,459	$ 2,736,024
Notes payable (Note 9)	296,000	—
Accrued annual leave (Note 1)	1,697,849	1,410,189
Accrued pension costs (Note 7)	202,752	166,285
Deferred revenue-donation of land (Note 10)	245,720	—
	6,188,780	4,312,498
Commitments and contingencies (Notes 2 and 5)		
GENERAL RESERVE		
Appropriated (Notes 5 and 6)	650,000	650,000
Unappropriated	9,146,590	7,098,402
	9,796,590	7,748,402
	$15,985,370	$12,060,900

The accompanying notes are an integral part of these financial statements.

INSTITUTE FOR DEFENSE ANALYSES
STATEMENTS OF REVENUE AND EXPENSE AND CHANGE IN GENERAL RESERVE

for the years ended September 30, 1986 and 1985

	1986	1985
REVENUE		
Contract revenue, including fixed fees of $2,493,335 and $1,840,098, respectively (Notes 1 and 2)	$60,564,585	$44,801,964
PROGRAM EXPENSE		
Charged to U.S. Government contracts:		
Direct salaries	21,012,346	15,861,118
Other direct costs	23,030,745	14,932,369
Indirect costs	14,028,159	12,168,379
	58,071,250	42,961,866
Charged to Institute projects:		
Direct salaries	25,566	132,479
Other direct costs	362,655	313,923
Indirect costs	163,217	243,136
	551,438	689,538
Total program expense	58,622,688	43,651,404
	1,941,897	1,150,560
INTEREST INCOME	106,291	115,908
Excess of revenue over expense	2,048,188	1,266,468
GENERAL RESERVE		
Beginning of year	7,748,402	6,481,934
End of year	$ 9,796,590	$ 7,748,402

The accompanying notes are an integral part of these financial statements.

INSTITUTE FOR DEFENSE ANALYSES
NOTES TO FINANCIAL STATEMENTS

1. Accounting policies

The following is a summary of the significant accounting policies utilized in the preparation of these financial statements.

Fixed assets, depreciation and amortization

Fixed assets are carried at cost. Depreciation of furniture and fixtures is computed on the straight-line method over the estimated useful life of the assets. Amortization of leasehold improvements is computed on the straight-line method over the lesser of the estimated useful life of the asset or the remaining term of the lease. Depreciation and amortization amounted to $574,388 and $501,173 for the years ended September 30, 1986 and 1985, respectively.

Costs directly identifiable with the purchase and construction of a building (see Note 10) are capitalized and will be depreciated on the straight-line method over the estimated useful life of the building once the building is placed in service. Total costs capitalized for the year ended September 30, 1986, were approximately $84,000.

At the time of retirement or other disposal of properties, the cost and related accumulated depreciation applicable to such properties are removed from the accounts, and resulting gains or losses on such disposal are credited or charged to operations. Maintenance and repairs are charged to operations as incurred; renewals and betterments are capitalized.

Contract revenue

All of the Institute's contracts are cost-plus-fixed-fee type contracts. Revenue from such contracts is recorded on the basis of direct cost and overhead incurred plus an allocable portion of the fixed fee.

Annual leave

Under the Institute's annual leave policy, employees are permitted to accumulate unused annual leave up to certain maximum amounts. The policy also provides for payment to employees of such unused amounts at termination or retirement. The Institute accrues annual leave as it is earned.

2. Government contracts

All of the Institute's business is with departments or agencies of the U.S. Government and is subject to audit by the Government. The Institute is unable to bill certain costs and fees until the government audits are completed and final settlement has been made. These costs and fees are included in unbilled accounts receivable.

Government audits have been completed through September 30, 1980, and the Institute is of the opinion that the reserve for possible disallowed costs is adequate to cover any amounts that may be disallowed for the period October 1, 1980 through September 30, 1986.

3. Accounts receivable

Accounts receivable at September 30, 1986 and 1985, consist of the following:

	1986	1985
Receivables from U.S. Government:		
Billed	$ 9,989,210	$ 6,071,614
Unbilled	1,467,675	1,267,414
	11,456,885	7,339,028
Reserve for possible disallowed costs	(300,400)	(100,400)
	$11,156,485	$ 7,238,628

4. Fixed assets

Fixed assets at September 30, 1986 and 1985, are summarized as follows:

	1986	1985
Deferred preoccupancy costs (Note 1)	$ 84,343	$ —
Furniture and equipment	2,887,384	2,715,375
Leasehold improvements	1,796,902	1,748,906
	4,768,629	4,464,281
Less accumulated depreciation and amortization	1,741,726	1,244,679
	$ 3,026,903	$ 3,219,602

5. Commitments

Minimum annual rental commitments under operating leases, principally for the rental of office space with initial or remaining noncancelable terms of more than one year, are as follows:

Year ending September 30	
1987	$ 4,185,600
1988	4,131,500
1989	3,341,300
1990	2,828,400
1991	2,170,900
Later years	9,917,700
	$26,575,400

Payment for property taxes, including increases therein, and for other expenses attributable to the leased property in certain leases and subleases.

The Institute has entered into two lease agreements relating to the rental of an office building in Princeton, New Jersey. The first agreement, which

began on April 21, 1975, is for 27 years and can be canceled after the seventh lease year. The second agreement relates to a building addition. This lease, which began on January 4, 1982, and extends to April 18, 2012, can be canceled on the earlier of April 30, 1987, or the termination date of the April 21, 1975 lease.

The Institute entered into an agreement to advance, under a second trust mortgage note, funds relating to the construction of the building addition. The balance outstanding on this note was $869,000 and $973,000 at September 30, 1986 and 1985, respectively. The mortgage note has a term of 10 years, which commenced January 4, 1982, and accrues interest at 12 percent per annum. The lease agreement provides for rental payments in the first 10 years (from January 4, 1982) in an amount sufficient to fund all payments due under the mortgage note, as well as a provision for cancellation of the balance due under the note should the lease be canceled. Since the mortgage note is effectively being repaid by the rental payments, the amount due under the note has been included with the caption "other assets" as prepaid rent.

If the cancellation rights under these lease agreements are exercised, the Institute will be required to pay a penalty. The penalty will include a termination payment of $644,000, which decreases monthly over the terms of the leases to $95,000, plus the outstanding balance of the mortgage note receivable plus any unpaid accrued interest. The maximum payment required by the Institute would be approximately $1,513,000 at September 30, 1986. The penalty payments are offset by a contract with the U.S. Government, which assumes, under the provision specified below, a portion of the liability. Under this provision, the U.S. Government will assume $700,000 of the penalty for five years from the date of occupancy of the building addition (January 4, 1982), which amount will be reduced by $10,000 per month for the next four years and by $220,000 in the tenth year. The U.S. Government is liable only in the event of the termination or nonrenewal of the contract. The Institute, by action of the Board of Trustees, has appropriated a total of $500,000 of the general reserve for such potential penalty payments. This appropriation will be reduced in accordance with the reduction in the contingent liability.

The Institute has also entered into a 20-year lease agreement relating to the rental of an office building in Alexandria, Virginia. The lease, which began January 20, 1982, may be terminated at any time subject to a penalty. The maximum penalty as of September 30, 1986, is $2,140,000 and declines by $133,750 each year thereafter. The penalty payment is fully offset under contractual agreements with the U.S. Government in the event of termination of these contracts.

Net rent expense for the years ended September 30, 1986 and 1985, was as follows:

	1986	1985
Gross rent expense	$3,986,337	$3,093,599
Sublease rental income	—	(402,483)
Net rent expense	**$3,986,337**	**$2,691,116**

6. General reserve appropriation

In addition to the appropriation of $500,000, discussed in Note 5, the Board

of Trustees, at its March 29, 1979, meeting, appropriated $150,000 of the general reserve, which represents expected costs of acquiring five acres of land for future development.

7. Retirement plan

The Institute has a contributory retirement plan for employees in which substantially all employees participate. Under the plan, the Institute makes contributions to an insurance company or a mutual fund, based on a percentage of the payroll of employees who participate in the plan. These contributions, together with employee contributions, are used to purchase annuities or units of participation in the mutual fund, the rights to which are immediately vested with the employee. Retirement plan costs are funded as they accrue, and there are no unfunded past service costs. The Institute's costs under the plan were approximately $2,255,000 and $1,765,000 for the years ended September 30, 1986 and 1985, respectively.

8. Income taxes

Under provisions of the Internal Revenue Code and the applicable income tax regulations of the States of Virginia, Maryland and New Jersey, the Institute is exempt from taxes on income other than unrelated business income. No provision for income taxes is required as of September 30, 1986 or 1985, since the Institute has no unrelated business income.

9. Line of credit

The Institute has a line of credit with its bank for $10,000,000, of which $296,000 was outstanding at September 30, 1986. The line of credit bears interest at the bank's prime rate and expires on January 31, 1988. Under the terms of the loan agreement, accounts receivable are pledged as collateral. The Institute is also required under the terms of the loan agreement, to maintain a positive working capital balance and a debt-to-worth ratio not to exceed 1.5 to 1.0. The Institute was in compliance with these convenants as of September 30, 1986.

10. Permanent Supercomputing Research Center (SRC) facility

The Institute is negotiating to construct a 117,000 square foot, secured facility to house the SRC in Bowie, Maryland. On July 25, 1986, the Carley Capital Group and the University of Maryland Foundation, Inc. (the grantors) donated to the Institute an approximate 14-acre parcel located within the University of Maryland Science and Technology Center in Prince George's County, Maryland. The land has been valued at $245,720, based on a notice of assessment, dated December 8, 1986, from the Prince George's County Office of the Maryland State Department of Assessments and Taxation. Under the property's Indenture Deed, the Institute must begin construction of the facility no later than 48 months after a final subdivision plat for the property has been approved and recorded, or title to the property will revert back to the grantors. As of September 30, 1986, the subdivision plat had not been approved. Therefore, the Institute has included the land value with the captions "other assets" and "deferred revenue-donation of land" in the balance sheet. In the event that the facility is not completed within thirty months, subject to a six-month extension, from the date construction begins, or, if completed, the

facility is not occupied and placed in service, or in the event that the Institute should sell, lease, abandon or terminate use of the facility within fifteen years from commencement of construction, subject to certain waivers, then the Institute will be obligated to pay to the grantors the fair market share of the property. If any event stated above occurs after five years, but prior to the expiration of the fifteen years from commencement of construction, then the purchase price will be reduced by 10 percent per annum for each full year which has elapsed after the fifth year until no obligation to pay any amount to the grantor exists after the fifteenth year.

In order to finance construction of the facility and costs associated with acquisition of the property, the Institute is negotiating for the issuance of an Industrial Development Bond (the Bonds) up to $13,000,000 from Prince George's County, Maryland. The Bonds will be amortized over 20 years from date of issuance and are structured as seven-day, variable-rate demand bonds containing a "put" option permitting the bondholders to put the Bonds back to the Institute or its designee at the end of each seven-day period. The Institute has also received a commitment for a $2,000,000 Maryland Industrial and Commercial Redevelopment Fund grant.

On October 2, 1986, the Institute entered into a commitment agreement with Sovran Bank N.A. (the Bank) whereby the Bank will make available to the Institute a letter of credit not to exceed $13,655,000, consisting of $13,000,000 with respect to the principal amount of the Bonds, $265,000 with respect to accrued interest at an assumed maximum rate of 12 percent per annum for a period of 62 days, and $390,000 with respect to a taxability premium of 3 percent of the principal amount of the Bonds, payable upon the occurrence of an event of taxability with respect to the Bonds. In the event that the principal amount of the Bonds is less than $13,000,000, corresponding adjustments to the foregoing amounts shall be made. The letter of credit, which is to secure the repayment of the Bonds, will expire 10 years and 62 days from the date of issuance. The Institute will reimburse the Bank, on demand, for all amounts paid by the Bank under the letter of credit, except for amounts paid by the Bank with respect to Bonds that are not remarketed, provided the Institute is making the Bond amortization payments. The reimbursement obligation of the Institute with respect to amounts paid by the Bank for Bonds that are not remarketed will bear interest based on the Bank's prime rate. The letter of credit will be secured by a first lien deed of trust granted by the Institute on the facility, including all land, buildings, improvements, furniture, fixtures and equipment owned by the Institute and comprising the facility and all leases and rents, inventory, accounts receivable, general intangibles, instruments and cash, and all proceeds therefrom derived by the Institute from operation of the facility. For as long as the letter of credit is outstanding, the Institute will pay an annual letter-of-credit fee equal to ⅞ of 1 percent of the maximum amount of the letter of credit which is scheduled to be outstanding for any year or a portion thereof. Under the terms of the letter of credit, the Institute will be required to maintain a minimum net worth of $7,000,000.